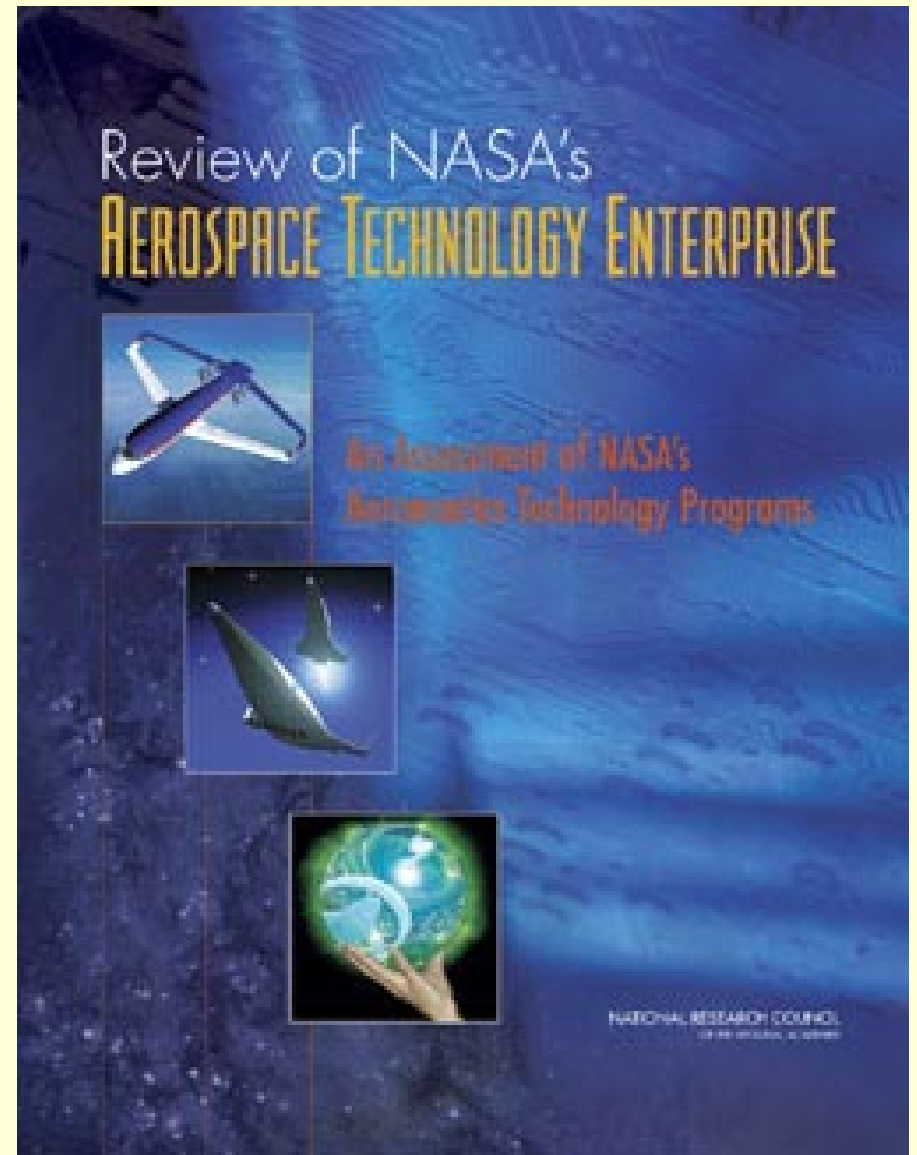# An Assessment of NASA's Aeronautics Technology Programs

February 2004

National Research Council
The National Academies

Dr. John Klineberg, Committee Chair

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The Study Process: Members

- **The NRC established three subject-specific panels to support the committee in its assessment:**
  - **Vehicle Systems Panel: 16 members**
  - **Airspace Systems Panel: 12 members**
  - **Aviation Safety Panel: 10 members**
- **Committee: 16 members (the chair plus 4 _ 6 members of each panel)**
- **Reviewers: 12 experts (all newly selected)**
- **All 51 participants were volunteers, motivated by a commitment to aeronautics technology and a desire to help improve Code R programs**

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2

Vehicle Systems Panel Members

- **Thomas L. Williams, Northrop Grumman, Chair**
- Mark J. Balas, University of Colorado at Boulder
- Robert C. Goetz, Lockheed Martin (retired)
- **S. Michael Hudson, Rolls-Royce, North America**
- Steven M. Iden, Lockheed Martin
- Sheila F. Kia, General Motors
- Gary H. Koopmann, Pennsylvania State University
- Harry A. Lipsitt, Wright State University
- **Lourdes Q. Maurice, FAA**
- Duane T. McRuer, Systems Technology (retired)
- **Theodore H. Okiishi, Iowa State University**
- **Tod Palm, Northrop Grumman**
- **Alfred G. Striz, University of Oklahoma**
- Mahlon S. Wilson, Los Alamos National Laboratory
- J. Mitch Wolff, Wright State University
- Michael J. Zyda, U.S. Naval Postgraduate School

Airspace System Panel Members

- **Frank Tung, Volpe National Transportation Systems Ctr, Chair**
- Charles B. Aalfs, Federal Aviation Administration (retired)
- Yaakov Bar-Shalom, University of Connecticut
- Barry Berson, Lockheed Martin Aeronautics
- **Walter S. Coleman, Regional Airline Association (retired)**
- William Dunlay, Leigh Fisher Associates
- Angela Gittens, Miami-Dade Airport
- **Robert Hilb, United Parcel Service of America**
- R. Bowen Loftin, Old Dominion University
- J. David Powell, Stanford University
- **Eduardo Salas, University of Central Florida**
- **Debra Winchester, Raytheon Company**

Aviation Safety Panel Members

- **Thomas B. Sheridan, Massachusetts Inst. of Technology, Chair**
- **Richard Abbott, Lockheed Martin Aeronautics Company**
- James W. Danaher, National Transportation Safety Board (ret)
- Valerie J. Gawron, Veridian Corporation
- Ronald A. Hess, University of California, Davis
- Adib Kanafani, University of California, Berkeley
- David Kohlman, Engineering Systems, Inc.
- **Raymond R. LaFrey, Lincoln Laboratory**
- John McCarthy, Naval Research Laboratory (retired)
- **Edmond L. Soliday, United Airlines (retired)**

The Study Process: Meetings

Meetings

- The panels and committee held 8 meetings between February and July of 2003 (21 days total)
- Four meetings were data-gathering sessions (NASA presentations) and four involved deliberations
- Vehicle Systems panel was asked by NASA to return in November 2003 to evaluate changes to Vehicle Systems Program (separate letter report was issued in January 2004)

Site Visits

- Members participated in 8 site visits to each of the NASA Research Centers (Langley, Ames, Glenn and Dryden) between March and May of 2003 (14 days total)

The Study Process: Methods

The panels evaluated questionnaires submitted by each PI (approximately 240 questionnaires)

- The panels produced detailed draft working reports for presentation to the committee
- The panels and committee evaluated the programs in the following four categories:
    - Portfolio
    - Program Plan
    - Technical Performance
    - User Connections
- The final written report was reviewed by a new group of experts for accuracy, logic, fairness, and completeness

Synopsis of the Report

- **Report contains findings and recommendations on three levels:**
  - **Top level cross-cutting recommendations - issues that were common for the entire set of programs (for HQ, Congress, OMB)**
  - **Program level recommendations for each program (for Center program and project managers)**
  - **Task level recommendations (for individual PIÅs)**
- **Report was released on November 12, 2003 as a draft document; the published (edited, bound) copy was released in late January 2004**
- **The committee believes the document contains many substantive recommendations that can be used to improve NASAÅs aeronautics technology programs**

TOP-LEVEL RECOMMENDATIONS

Top-Level Recommendation 1

The government should continue to support air transportation, which is vital to the U. S. economy and the well-being of its citizens.

- A strong national program directly contributes to the vitality of the U.S. aeronautics industry, the efficiency of the U.S. air transportation system, and the economic health of the United States.

- The government has an important role in assuring the best possible air transportation system and in the development of related technologies that enable products and services to compete effectively in the global marketplace.

Top-Level Recommendation 2

NASA should provide world leadership in aeronautics research and development.

- To provide leadership, NASA should develop consistent strategic and long range plans to focus the aeronautics program in areas of national importance.

- NASA should have well formulated, measurable, attainable goals at all program levels based on a sound evaluation of future needs, technological feasibility, and relevant economic and other non-technical factors.

Top-Level Recommendation 3

NASA has many excellent technical personnel and facilities to achieve its aeronautics technology objectives but should improve its processes for program management.

- Many NASA facilities are world class national assets, and the committee was impressed with the technical expertise of many program personnel.

- NASA needs to improve its program management and systems integration processes and assure clear lines of responsibility and accountability.

- NASA should use independent quality assurance processes for program evaluation, and all projects should be evaluated regularly.

Top-Level Recommendation 4

NASA should eliminate arbitrary time constraints on program completion and schedule key milestones based on task complexity and technology maturity.

- NASA should resist constant changes and realignments designed to meet artificial 5-year sunset requirements.

- Continuous reorganization creates an unstable atmosphere that does not permit NASA researchers to pursue the best path to technology maturation.

- NASA programs need clear exit criteria at the task level to define when research is complete or ready for transition to industry or other agencies.

Top-Level Recommendation 5

NASA should reduce the number of tasks in its aeronautics technology portfolio.

- NASA is trying to do too much on the available budget. Often there are too many tasks to achieve research objectives in

    key areas.

- The breadth of activities appears to come at the expense   of depth.

Top-Level Recommendation 6

NASA should pursue more high-risk, high-payoff technologies.

- Many innovative concepts will not be pursued by industry or the FAA but are critical to meeting aviation needs in the next decades. NASA should fill this void.

Top-Level Recommendation 7

NASA should reconstitute a long-term base research program, separate from the other aeronautics technology programs and projects.

- The current research is mostly product driven, with not enough fundamental work. NASA needs to provide researchers the opportunity to conduct forward looking, basic research unencumbered by short term, highly specified goals and milestones.

- NASA needs to reassess its core competencies and assure their support through a base research program.

Top-Level Recommendation 8

NASAÅs aeronautics technology infrastructure exceeds its current needs, and the agency should continue to dispose of underutilized assets and facilities.

- NASA test facilities create large fixed costs. Some of these facilities are not unique, and long term fixed costs could be reduced through selected consolidation and deactivation.

Top-Level Recommendation 9

NASA should implement full-cost accounting in a way that avoids unintended consequences harmful to the long-term health of the aeronautics program.

- If not carefully managed, full-cost accounting could hurt the R&D process by delegating responsibility for preserving institutional capabilities to lower-level program managers.

- Researchers may be less willing to take a project to a high level of technology readiness because the entire expense of wind-tunnel or full-scale flight tests will be applied to their budgets.

- Budgets must be carefully realigned to support full-cost accounting. Large infrastructure costs, such as wind tunnels and full-scale flight testing, should be attributed to the total program.

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Top-Level Recommendation 10

NASA should develop a common understanding with the Federal Aviation Administration (FAA) of their respective roles and relationship.

- NASA officials need to recognize that implementation decisions rest with the FAA management, and advocacy by NASA, when it runs counter to the FAA, is not helpful.

- Many NASA personnel measure the success of their research solely by the extent to which customers incorporate NASA research in their operational systems.

- As NASA research approaches the point where the value of continued development is contingent on operational implementation, NASA should close out projects that have low probability of implementation.

Top-Level Recommendation 11

NASA should seek better feedback from senior management in industry and other government organizations.

- NASA should improve its relationships with the FAA and other customers by involving them from the early stages of the R&D process through field implementation.

- One method for improving interactions would be for NASA to convene a yearly meeting, co-chaired by the FAA and NASA Administrators, with COO-level industry executives. Topics should be limited to near-term issues and implementation plans.

Top-Level Recommendation 12

NASA should conduct research in selective areas relevant to rotorcraft.

- NASA should ensure that their research programs in general aviation and transport aircraft consider the potential applications to rotorcraft.
- NASA should take advantage of existing industry research and development in rotorcraft and should leverage the U.S. Army programs in rotorcraft technologies.

Future Plans

Center Visits

- Committee members plan to visit the Centers to explain findings and recommendations directly to the researchers in February 2004.

Annual Updates

- Committee members would like an informal, yearly update on the Aeronautics Technology Programs to provide continuity in the reviews.

Ongoing Triennial Assessments

- The NRC is scheduled to complete this review again in 2006.